Driving Under the Influence of Risky Peers: An Experimental Study of Adolescent Risk Taking

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Abstract

Both passive and active social influences may affect adolescents' dangerous driving. In the present study, we used an experimental paradigm to delineate these two influences with actual peers. Adolescents completed a simulated driving task and we measured risk preferences of each member the peer group. We used hierarchical linear modelling to partition variance in risky decisions. Adolescents experienced many more crashes when they had "passengers" present who reported a strong preference for risk taking and who actively provided decision making guidance. Although youth in the passive peer condition were also influenced by the riskiness of their peers, this relation was less strong relative to the active condition. We discuss the need for interventions focussing on active and passive peer influence.

Keywords: Risk Taking; Driving Risk; Peers; Context; Gender.

Driving Under the Influence of Risky Peers: An Experimental Study of Adolescent Risk Taking

Public health experts have long recognized that the developmental period of adolescence is a critical period of risk, as adolescents are disproportionately involved in dangerous behaviors relative to other age groups (CDCP, 2012b). One of the clearest developmental features of adolescent risk taking is that it nearly always occurs in the presence of familiar individuals. For instance, automobile accidents are the leading cause of death and injury among adolescents; accident rates among adolescents increase greatly when passengers are present (CDCP, 2012b; Doherty, Andrey, & MacGregor, 1998). Indeed, the fatality risk among 16 to19 year-old drivers increases by about 500% when there are passengers present, relative to when there are not (Doherty et al., 1998).

Adolescents' increased propensity for risk taking, including risky driving, may be partially attributable to an "affective overdrive" that occurs during this developmental period. A growing body of research suggests a developmental incongruence in the neurobiological systems that govern adolescent decision making, such that a mature appetitive approach system is paired with a less synchronized, arguably less mature regulatory control system (Casey & Jones, 2010; Casey, Jones, & Somerville, 2011; Somerville, Jones, & Casey, 2010). As a result of this developmental mismatch, socio-emotional rewards may be particularly influential to risky and antisocial choices, rather than perceived costs (Shulman & Cauffman, 2013). In particular, peer approval is a highly salient reward that appears to act as a catalyst for adolescents' propensity for risk taking (Cauffman et al., 2010; Figner, Mackinlay, Wilkening, & Weber, 2009; Modecki, 2009).

Given evidence that peer approval is a key driver of adolescent risk taking, it is important to understand the different mechanisms by which peers endorse or sanction youths' risky choices. Illustratively, the social psychological literature is rich in describing many forms of social influence that peers can exert, from subtle nudges that are transmitted through implicit messages and modelling to overt pressure and encouragement (Allen et al., 2012; Piehler & Dishion, 2007; Rambaran et al. 2013). Some of the influence exerted by peers may be explicit. Friends may directly embolden youth and reinforce risky behaviors (Allen, Porter, & McFarland, 2006; Dishion, Spracklen, Andrews, & Patterson, 1996). However, peers also may implicitly exert influence on adolescent behavior vis- à -vis status enhancing norms, and other social-cognitive mechanisms (Centifanti & Modecki, 2013; Cohen & Prinstein, 2006; Rebellon & Modecki, 2013).

In particular, the social influence framework delineates two pathways by which peers exacerbate adolescent risk, one passive and the other active (Borsari & Carey, 2001). The passive pathway describes implicit norms, and perceived gains in peer status and approval that may be attained through risky choices. In contrast, the active pathway describes more overt forms of pressure to engage in risk, such as goading, urging, or communicating disapproval around risky choices. Thus far, a growing literature has simultaneously described these two processes in models predicting youthful alcohol drinking and smoking (Wood, Read, Mitchell, & Brand, 2004; Wood, Read, Palfai, & Stevenson, 2001). Peers appear to convey both passive and active influence on adolescent substance risk (Wood, Read, Mitchell, & Brand, 2004), but passive peer approval may be most predictive of adolescent risk taking in general (Harakeh, & Vollebergh, 2012; Reed & Roundtree, 1997; Wood et al., 2001).

However, research to date has focused largely on social influences within substance use decisions, even though both passive and active forms of peer influence likely play a role in other risk behaviors, including risky driving. In fact, the social influence model is especially relevant to adolescent driving, because driving is a distinctively social context. The adolescent driver is forced to adhere to rules and regulations of the road or, alternatively, gain potential status and popularity by driving in a risky manner (Allen & Brown, 2008). Further, youthful passengers may exert passive social influence just by being in proximity of the driver (Harakeh, & Vollebergh, 2012). Peers may passively transmit descriptive norms for risky driving, even without direct persuasion or reinforcement. Adolescent drivers may implicitly perceive that they will be rewarded for, and their peers will value, risk taking (Carter, Bingham, Zakrajsek, Shope, & Sayer, 2014). Of course, youth may also actively socialize adolescent drivers via overt communication about and pressure to take risks (Allen & Brown, 2008).

Although driving is a highly salient context for understanding passive and active peer influences to take risks, only a few studies have examined these social influences within risky driving. Further, because these studies have only investigated one socializing influence at a time, it remains unclear which is particularly influential to adolescent driving decisions. For example, one recent study suggests peers can exert passive pressure about risky decisions without direct communication (Simons-Morton et al., 2014). Using confederates to passively convey risk-norms, Simons-Morton and colleagues (2014) demonstrated that risk-accepting passengers increase and risk-averse passengers decrease adolescents' dangerous driving. These and other authors argue that passive and not active socialization is the primary influence youth experience while driving (Ouimet et al., 2013; Simons-Morton et al., 2011).

Peer influence is not only exerted through passive channels; adolescent passengers actively influence drivers to take risks, as well (Allen & Brown, 2008). Research on active influence is only slightly more extensive, but provides some experimental evidence of active peer influences on adolescent driving. For instance, confederates are able to actively alter older adolescents' driving behavior, and can reliably motivate youth to increase or reduce risky driving (Lane, Tapscott & Gentile, 2011). Moreover, peers can also actively induce teen drivers to take more risks. In an innovative experimental study, Gardner and Steinberg (2005) assigned youth to complete a simulated driving task either alone or with “active” peer passengers who communicated and engaged with the driver during the task. Youths with active peer passengers took more risks than youths who drove alone, suggesting that the general effect of active peer influence may be in the direction of increased, rather than decreased, adolescent risk taking.

Thus, peers could exert both passive and active social influences to affect youthful driving. However, almost all experimental investigations of peer influence on adolescent driving have been based on confederates (e.g., Simons-Morton et al., 2014) or arranged adolescent peers (e.g., Gardner & Steinberg, 2005) in lieu of actual friends. In the real world, risky driving occurs in the presence of friends who impel youth to take risks – either passively or actively, and not with unfamiliar passengers (Doherty et al., 1998). The absence of actual peers in the literature is particularly important, because adolescents may be more motivated to manage impressions (to convey a particular identity or status) when interacting with acquaintances or strangers rather than friends (Leary et al., 1994). Thus, whether actual peers exert passive and active social influences on youthful driving remains an unanswered question.

These gaps in the literature are important, because preventive interventions need to target specific mechanisms of peer influence on adolescent driving, and different tactics are required to combat different forms of social influence. To reduce passive influences from risky peers, programs need to focus on countering perceived peer norms and bolstering adolescents’ self-monitoring to diminish the negative effects of subtle and implicit peer influences (Perrine, & Aloise-Young, 2004). To diminish active influences from risky peers, programs need to target refusal and resistance strategies that allow youth to deflect overt pressures to take risks (e.g. Botvin & Griffin, 2004). Importantly, too, social influence models call for peers’ ability to *diminish*, not simply to increase, adolescent risk taking

(Hogg, Turner, & Davidson, 1990). Not all adolescents are risk takers, and understanding peers' ability to reduce dangerous driving through passive versus active channels is also of considerable translational importance. For example, one possibility is that risk-averse passengers exert passive, but not active influences to diminish driving risk. Given adolescents' general propensity for risk taking (Gardner & Steinberg, 2005), youth may be reluctant to hazard loss of status by communicating risk aversion through active channels.

Study Overview

In summary, both passive and active social influences may affect adolescents' dangerous driving. Despite the established link between peer passengers and dangerous driving, there has been relatively little study of peers' social influence on adolescents' driving whether passive or active. Several studies provide preliminary support for the ability of confederate peers to alter youths' risky driving, but no study has yet examined social influences exerted by actual peers in the vicinity of youthful drivers. The current study focuses on two issues that could help in understanding passive and active processes by which peers influence risky driving.

First, we compared two models of peer influence – one designed to allow active peer influences on youthful driving, and the other designed to allow more subtle forms of passive influence. As noted above, if risky driving is attributable to passive routes, adolescents should increase or decrease their risk taking according to their peers actual risk preferences, even without active communication. Likewise, if risky driving is caused by active routes, adolescents with "active" passengers should also drive in accordance with their peers' risk. The main question and contribution of this study, however, is whether peers exert a stronger effect on driving via passive versus active routes. Implicit in this question too, is whether youths with less risky friends are "pulled" in the direction of diminished risk taking via passive or active channels.

Second, we examined gender as a potential moderator of the peer-influence effect. Gender-specific socialization patterns are often found in the context of interaction effects, though results have been equivocal (Brechwald & Prinstein, 2011). For example, Shepherd, Lane, Tapscott, and Gentile (2011) found female adolescents were more affected by risk-encouraging confederate peers than males. On the other hand, Gardner and Steinberg (2005) found that males, but not females, weighed benefits more heavily when in a group versus alone. Additionally, other studies have demonstrated that males were more likely to brake later and harder (Simons-Morton, Ouimet, Wang, Klauer, Lee, & Dingus, 2009) and to drive aggressively (in fatal crashes) when with peers relative to when not (Lambert-Bélanger, Dubois, Weaver, Mullen, Bédard, 2012).

In the present study, we used an experimental paradigm to delineate two social influences, passive and active, with actual peers. Adolescent participants were recruited and asked to bring two friends, because actual friends, not unfamiliar individuals, are the primary channel of influence for youths' risk decisions. Adolescents completed an ecologically valid simulated driving task in which youths "drove" accompanied by loud rock music. Further, we measured risk preferences of each member of adolescents' peer group in order to investigate the effects of risk-inclined versus risk-averse peers under real-world conditions. We then used hierarchical linear modelling to methodologically partition any variance in risky decisions that was due to individual-level traits (individual's risk preference) versus proximal, peer-level attributes (peer group's risk preference). Because risky behavior can manifest through different driving-related outcomes (Pradhan et al., 2014), three different dependent variables were included in the models: self-reported risk preference, failure-latency to brake, and crashes.

Although adolescents select friendships with peers who mimic their own risk taking, our experimental manipulation of mechanisms for peer influence (active versus passive) allowed us to better attribute risk taking to specific channels of influence rather than to simple selection effects. We used an experimental paradigm to manipulate peer influence rather than using peer network analyses which more aptly capitalize on changes in the peer group that may happen organically, and which underlie peer selection and influence (Brechwald & Prinstein, 2011). Notably, we investigated the between-level interaction between experimental condition (i.e. passive versus active as a between-group effect) and the slopes that described how peers' risk preferences (between-group effect) were related to the target's decisions to take risks. Likewise, we examined the between-group interaction between condition and the target's gender to further examine potential gender-based socialization effects. Above and beyond conditional main effects of peer groups' risk preferences – likely reflecting selection effects – on each of the dependent variables, these interactions designate different socializing effects for passive and active conditions.

Method

Participants

Participants (N=675) were recruited from sixth-form schools (final two years of secondary education) in the northwest of England, which enroll students in 11th and 12th grades. Seven schools were contacted and all agreed to participate. However, only six schools were included due to administrative problems at one school. The final sample (52% female) included participants ranging in age from 16 to 20 years (M= 16.8, SD= .8), with over 80% between 16 and 17 years of age. Participants mainly self-identified as White British (64%), with the largest minority group being Pakistani (25%). The most common levels of education completed by participants' mothers were university (43.4%) and secondary school (39.1%); for fathers, the most common were secondary school (42.2%) and university (40%). Five percent reported their mother or father did not attend school. Based on the United Kingdom's school-governing body's statistics, the schools we recruited were in economically-deprived neighborhoods and the student body reflected these communities, with half the students receiving maintenance grants (i.e., free school meals). One school was in a community which was ranked the 12th most-deprived in the UK. Indeed, all communities sampled had high levels of unemployment. We selected schools in these areas to oversample youths with high levels of risk taking behaviors.

Measures

Risk preference. Preference for risk taking was assessed using risky scenarios from the Youth Decision-Making Questionnaire (YDMQ) (Ford, Wentzel, Wood, Stevens, & Siesfeld, 1989). Participants read five hypothetical vignettes, asking them to rate how likely they would be to engage in different activities, such as allowing friends to bring drugs into one's home, taking a car for a ride without the owner's permission, deciding to cheat on an exam, shoplifting, and skipping work. Additionally, participants were told their decisions may result in negative consequences (e.g., police arrest), requiring the participants to make a decision in the face of possible risks. The five dilemmas were the most clear-cut scenarios of social acceptability of right and wrong (Cauffman & Steinberg, 2000; Gardner & Steinberg, 2005) and include a degree of conflict between choosing the socially moral act and the socially irresponsible course of action. Thus, participants rated these on a four-point scale of (1) 'would definitely not allow it' to (4) 'would definitely allow it.' Participants in all conditions were required to circle their response on their own questionnaire, independent of their peers. Participants' scores were calculated by adding the decision making ratings across the five vignettes (M= 8.97, SD= 2.77), and the internal consistency was acceptable (Cronbach's alpha= .65). Peer levels of risk preference were calculated as a sum of the two friends' risk preference scores. Prior research has shown that risk preference was related to laboratory risk taking (Gardner & Steinberg, 2005) and supports the use of the YDMQ as a valid assessment for real-life decision making. In fact, ratings on the YDMQ have been shown to be related to delinquent behavior (Cauffman & Steinberg, 2000; Modecki, 2008) and substance abuse (Magar, Phillips, & Hosie, 2008).

Risky driving. Participants completed a driving simulation task called Stoplight (Steinberg et al., 2008). In this task, participants took the point of view of the driver behind the wheel. The goal was to arrive at their destination within five minutes. A countdown clock was shown on the screen, and participants were told they needed to arrive at their destination before time ran out. Participants passed through 20 intersections marked by traffic lights on the way. The task was programmed to include scheduled safe (no possibility of a crash) and unsafe (a crash is certain) intersections. The lights turned yellow as participants approached an intersection. To raise the level of uncertainty, the timing between light changes (i.e., green to yellow, and yellow to red) and probability of a crash varied across intersections. Participants stopped their “car” by pressing the spacebar on the keyboard. Participants were told they could stop only after the light had turned yellow and they could not control the pace of the car. They were also told that stopping at the yellow or red light would cost them time, but crashing would cost them more time. Thus, participants had to weigh the risks of crashing and losing time against their ultimate goal of arriving to their destination on time (Steinberg et al., 2008). Unlike prior risky driving tasks (Gardner & Steinberg, 2005), the Stoplight task measures passive risk taking (i.e., pressing a key to make a “stop” response) instead of active risk taking (i.e., pressing a key to make a “go” response).

We measured each participant’s latency to brake (time difference, in milliseconds, between the light turning yellow and the point of applying the brakes), failure to brake (time difference between light turning yellow to crash or light turning red) and the number of crashes. As in prior research using this task (Steinberg et al., 2008), the two timing measures were summed to create a measure of failure-latency to brake. In the present study, the mean of these summed measures was 28,540 (SD=6555) milliseconds. This combined measure reflected the participants' decision to continue to approach the intersection and to use the available (stopping) time to decide to go through the intersection. Steinberg and colleagues have shown that both failure-latency to brake and number of crashes on the Stoplight task were related to self-reported sensation-seeking but not to self-reported impulsivity (Chein et al., 2011; Steinberg et al., 2008). In the present study the mean number of crashes was 4.30 (SD = 1.90). In Steinberg and colleagues' (2008), the number of safe stops was unrelated to the main study variables, so we did not include this measure in the present study.

Procedure

The research was conducted with the approval of the university ethics committee, and the methods and materials were reviewed by each Head of School to act *in loco parentis* (i.e., on behalf of parents). Participants were at least 16 years old, and in the UK they could legally consent to participate. Participants were recruited asking them to take part in a study on "decision making on scenarios involving risk," but were not informed about the aims to look at the effects of peers in the two conditions. Groups of three (N=225) same-sex participants arrived to an area of their school that was designated to the research team. Consistent with past experimental research on peer influence, which has examined individuals of the same sex (e.g. Gardner & Steinberg, 2005) and in order to decrease extraneous variability between groups, the decision was made to focus solely on groups of the same sex. Thus, participants were asked to come with two same-sex friends in order to participate. Participants were briefed in groups, but were asked to give consent individually. Next, all friendship groups were randomly assigned to complete the study materials and tasks either together in their group (i.e., active influence condition; N= 110) or independently (i.e., passive influence condition; N= 115).

Testing was dictated by the layout of the school classroom or testing area available, while also ensuring the two experimental conditions proceeded according to our procedure.

In some schools, we had multiple testing rooms to separate groups of participating youths. In others, we used classrooms that were partitioned to ensure procedures were followed with regard to the group and independent conditions. Research assistants (advanced undergraduate and postgraduate university students) were employed to ensure proper procedures were followed in each case. Therefore, across conditions, researchers were nearby to ensure compliance with experimental conditions.

The questionnaires and tasks were counterbalanced for order. All participants regardless of condition were told they could win £2 depending on their performance on the first task they completed, either the driving task or another risk taking task (reported in Centifanti & Modecki, 2013). Further, if they performed well on both (e.g., fast time to arrive to destination on Stoplight), they won £5. All participants won £2 on the first risk taking task, to ensure the motivation to win £5 was equivalent across participants for the second risk taking task. Thus, winning £5 was contingent on performance on the second risk taking task. All participants were fully debriefed at the completion of the study with each school.

Group condition. The group condition differed from the independent condition in that participants discussed the scenarios on the risk-preference questionnaire as a group prior to making their ratings using a clipboard for privacy. They were told they could mark their own answer regardless of the group's discussion, paralleling Gardner and Steinberg's (2005) procedure. For the Stoplight task, one person in each group condition was randomly chosen by roll of a die to control the keyboard. Participants in the group condition who were not in control of the keyboard were told to give verbal advice to their friend (i.e., the target participant). This procedure mimics Gardner and Steinberg's (2005) group condition. While one participant was driving, the other two were told that they could call out advice about whether to keep moving or stop the car. Data involving the group's measures of driving risk taking were included only on the target's row of data.

Independent condition. Participants in the independent condition did not discuss the hypothetical scenarios on the risk preference questionnaire, but were in the presence of their peers as they made their ratings on their clipboards. For the driving task, participants were given noise-reducing headphones and were seated so they could not observe each other's driving. Participants could not see each other's driving performance because testing was done with either monitors back-to-back or with partitions to hide monitors. However, participants were able to see their peers, which meant their peers were present, but any "active" influence was essentially removed from the independent condition.

Data Analysis Plan

All participants completed the risk preference questionnaire which yielded 675 data points. The risky driving task generated one score per individual (n=345) for participants in the independent condition and one score per group in the group condition (n=110) because in the group condition only one designated person controlled the car (i.e., keyboard).

The data were analyzed with restricted maximum likelihood estimation (RML) using hierarchical linear modeling (HLM) analyses in ML Win version 2.30 to account for the nested structure of the data. In these data, individuals were nested within peer groups. Traditional analytic approaches such as OLS regression would ignore cluster membership, violating independence and leading to Type 1 errors. In addition, relations observed at one level (e.g., group level) do not necessarily generalize to other levels (e.g., individual level). HLM overcomes these issues and analyzes variables at different levels of the hierarchy (individuals nested within groups). The cluster-level variable (peers group's risk preference) was grand-mean centered prior to analysis, and the target's risk preference (individual level) was group-mean centered. This is in line with recommendations for exploring cross-level interactions in multi-level modeling (Enders & Tofighi, 2007).

Following Raudenbush and Bryk (2002), we began by running a fully unconditional (null) model (akin to a one-way random effects ANOVA), to partition within- and between-group variance in each outcome. That is, the null model included the standard regression equation, $y_{ij}=\beta_0 + e_{ij}$ where *i* is the within-variance (i.e., individual-level) and *j* is the between-group variance (i.e., peer-group-level) calculated in an OLS regression. In the OLS regression, the predicted value of the dependent variable, *y*, is determined by the intercept (β) and residual error. The between-group variance is then added to the equation, $y_{ij}=\beta_{0j} + e_{ij,}$ where *j* is included in the random-intercept. The between-group variance accounts for similarity within peer groups. In our data, peer groups significantly differed on mean dependent variable levels for risk preference (between-group variance accounted for 55% of the variance) and failure-latency to brake (between-group variance accounted for 14% of the variance). Thus, this indicated the need to run random-slope models for risk preference and failure-latency to brake. However, peer groups did not exhibit significant variability in crashes (including between-groups variability resulted in a non-significant improvement in model fit), and this dependent variable was examined using random-intercept (standard OLS regression).

Our data only had 1.7% missing, all of which was on the dependent variables, for which ML Win uses list-wise deletion. Models involving risk preference included all 675 participants. Models involving the group measures of driving risk taking included only the target's data; the peers' data (only for the dependent variable of risky driving) were treated as missing (i.e., similar to redundant).

In the models, independent variables were added in steps. Robust overall model chi-square difference tests (using the -2 log-likelihood [-2LL] differences and differences in degrees of freedom) were used to evaluate improvement of fit between steps in the models (Bartholomew, Steele, Galbraith, & Moustaki, 2008). Separate models were run for risk preference, failure-latency to brake, and number of crashes (results were similar using

Poisson regression models).

For the dependent variable of risk preference, our model included the independent variables of gender (between), condition (between), and peer-group risk preference (between) on Step 1: $y_{ij}=\beta_{0j} + \beta_{1j}$ (Gender)$_j$ + β_{2j} (Condition)$_j$ + β_{3j} (Peer Risk)$_j$ + e_{ij}. The between-level model is $\beta_{0j} = \Theta_{00} + \Theta_{1j}$ (Gender) + Θ_{2j} (Condition) + Θ_{3j} (Peer Risk) + u_{0j} where Θ_{00} is the adjusted mean target risk preference, u_{0j} is the unique effect of peer group on target risk, and Θ_1 through Θ_3 are the regression coefficients for the main effects, and Θ_4 through Θ_5 the regression coefficients for the interaction terms specified. That is, we next entered the peers' risk preference by condition (between-level interaction) and gender by condition interaction (between-level interaction) terms on Step 2. Significance of the interactions entered on Step 2 was determined by a significant reduction in model fit (indexed by the -2LL). Significant interactions were probed by solving the regression equation at high (+1SD) and low (-1SD) levels (Aiken & West, 1991; three-way interactions were probed but were non-significant).

For the dependent variables of failure-latency to brake and number of crashes, our models included self-reported (target) risk preference (within) and peer reported risk preference (between) as independent variables ($y_{ij}=\beta_{0j} + \beta_{1j}$ (Gender)$_j$ + β_{2j} (Condition)$_j$ + β_{3j} (Target Risk)$_{ij}$ + β_{4j} (Peer Risk)$_j$ + e_{ij}). Thus, we examined their effect, in addition to gender and condition, on the focal dependent variable on Step 1. For failure-latency to brake model, the intercept was allowed to randomly vary and the within-variance was accounted for by peer risk preference and this was reported in both Steps 1 and 2. That is, this is a complex model where the amount of variation among individuals depends on the peer-group's reported risk preference (reflecting cross-level effects) was estimated as above, but $\beta_{4j} = \Theta_9 + u_{4j}$ with u_{4j} as the unique effect of peer risk preference on failure-latency to brake. To examine whether those with greater risk preference engage in greater risk taking when actively versus passively influenced, we examined the target risk X condition interaction. To examine whether having riskier peers relates to risk taking in passive versus active conditions, we examined the peer risk X condition interaction. Further, the target risk X peer risk interaction allowed us to examine whether those with greater risk preference take greater risks when with peers higher in risk preference, regardless of condition. Finally, we also looked at the gender X condition interaction. Two-way interactions were run on a separate step.

Results

First, demographic measures were examined with regard to the dependent and independent variables. While males were equally represented across ethnic categories (50% in each), females who participated were more representative of the majority ethnic group (66%; χ^2 (1)= 16.15, $p < .001$). Nevertheless, ethnic majority versus ethnic minority status did not differentiate performance on any of the risk taking measures (i.e., crashes, failure-latency to brake, and the reported risk preference).

Risk preference and laboratory measures of risk taking were significantly correlated (*r*s ranging from .11 to .14), yet the effect sizes were small, possibly reflecting the subjective versus objective measures of risk taking, though may also reflect the different domains specific to risk taking. Risk preference strongly correlated with peers' risk preference (*ICC* = .53, $p < .001$). Thus, youths and their peers were similar in their preference for risk taking. Peers' risk preference was also significantly correlated with failure-latency to brake ($r = .12$, $p < .05$).

Table 1 describes the random-effects model for the dependent variable of the target's risk preference. Confidence intervals were included to show the magnitude of the effect sizes. Confidence intervals that are further away from zero denote stronger effect sizes and confidence intervals which include zero are nonsignificant. On step 1, female gender predicted lower risk preferences. Further, youths reported a stronger risk preference when their friends reported a stronger risk preference (β = .29, SE = .02, 95% CI = .25, .33); this was a moderate to large effect size (Bartholomew et al., 2008). Including the interactions on step 2 yielded a significantly improved model, as indicated by a significant reduction in -2LL. On step 2, the between-group interaction between peer group risk preference and condition was significant (β = .15, SE = .04, 95% CI = .07, .23), with a beta over three times the size of the standard error indicating a large effect size. The form of this interaction is shown in Figure 1. The positive slope of peer risk preference on the target's risk preference was more pronounced in the group condition (β = .38, SE=.02, 95% CI = .34, .42) than in the independent condition (β = .18, SE=.04, 95% CI = .10, .26). Thus, there was greater conformity with peers in the group condition where they actively discussed risk taking with peers than in the independent condition where they were simply in the presence of peers. Gender did not significantly interact with condition, so this was removed from the final model.

Table 2 notes the results of the random-effects model for failure-latency to brake (left) and the fixed-effect model for crashes (right). On the left-hand side of the table, for failure-latency to brake, there was a significant main effect on step 1 for peer risk preference (β = 107.01, SE=49.23, 95% CI = 10.52, 203.50). Having peers in the peer group who reported stronger risk preferences was related to longer time periods before braking (measured in milliseconds) at intersections. Including the interactions on step 2 resulted in a significant reduction in the -2LL. A condition main effect was also revealed in the final model including the interaction terms; higher target risk preference predicted longer decision making times at intersections (β = 477.38, SE=198.87, 95% CI = 87.60, 867.17). As above, gender did not significantly interact with condition and was removed from the final model.

The interaction between target risk preference and peer risk preference on failure-latency to brake was significant (β = -67.70, SE=25.85, 95% CI = -118.37, -17.03) and was of a moderate effect size. Thus, the relation between peers' risk preference and latency to brake was influenced by the risk preferences of the target participant. At high target risk preference (+1SD), peer group risk preference was positively related to risky decision making (β = 208.61, SE=88.29, 95% CI = 35.56, 381.66); this was a significant simple slope. At low risk preference (-1SD), peer group risk preference was negatively related to risky decision making, but this was not a significant simple slope (β = -10.87, SE=83.48, 95% CI = -174.49, 152.75). The form of the interaction with 95% CIs is illustrated in Figure 2. As shown, above and beyond effects of factors such as condition and peer group risk, high risk preference individuals normalized their risk taking toward their peer group's risk preference by taking more risks at intersections when their peer groups was risky, and by taking fewer risks at intersections when their peer group was less risky.

There was also a significant interaction between target risk preference and condition (β = -1179.68, SE=570.89, 95% CI = -2298.62, -60.74) on failure-latency to brake. This interaction showed that, for the independent condition, target risk preference was positively related to risky decision making (β = 297.30, SE=188.89, 95% CI = -72.92, 667.52), while target risk preference was negatively related to risk decisions in the group condition (β = -965.49, SE=541.81, 95% CI = -2027.44, 96.46). However, neither slope was significant. Thus, passive peer influence may enhance congruity between own preference for risk and actual risk taking; whereas active peer influence reversed the relation between own risk preferences and taking risks at intersections.

The random-intercept model for crashes is shown on the right-hand side of Table 2. On Step 1, gender was a significant predictor of crashes: females had fewer crashes than males (β = -.47, SE=.19, 95% CI = -.84, -.10). Including the interactions on step 2 resulted in a significant improvement in fit. First, as shown in Step 2, condition main effects were found for peer group risk preference and for target risk preference. Youth took more risks resulting in crashes when in riskier peer groups than when in peer groups with lower levels of risk preferences (β = .02, SE=.01, 95% CI = .00, .04), but this was a very small effect, given the nearness of the confidence interval to zero. Further, higher target risk preference predicted a greater number of crashes (β = .13, SE=.06, 95% CI = .01, .25).

Further, three significant interaction effects emerged. First, a significant interaction was found between peer risk preference and condition (β = -.08, SE=.03, 95% CI = -.14, -.02); this was a moderate-sized effect. Figure 3 illustrates the form of the interaction. In the group condition, higher group risk preference resulted in riskier driving (more crashes), and lower group risk preference resulted in less risky driving (resulting in fewer crashes); whereas in the independent condition, risky driving resulting from crashes was unrelated to peer groups' risk preference. Probing of the simple slopes indicated that the effect of peer risk preference was significant for the group condition (β = .11, SE=.04, CI = .04, 1.72) but not for the independent condition (β = -.01, SE=.02, CI = -.05, .03) as indicated by the absence of zero within the confidence interval for the group condition.

There was also an interaction between target risk and peer risk preference (β = -.02, SE=.01, 95% CI = -.003, -.04), similar to our model predicting failure-latency to brake, but of a small effect size. The form of the interaction closely resembles Figure 2. Specifically, at high target risk preference (+1SD), peer group risk preference was positively related to risky driving resulting in crashes (β = .03, SE=.03, 95% CI = -.03, .09); although the simple slope was not significantly different from zero. At low risk preference (-1SD), peer group risk preference was less strongly related to risky decision making and peer risk was negatively linked with crashes. Again the simple slope for the low risk preference was not significant (β = -.01, SE=.02, 95% CI = -0.05, 0.03).

Finally, the gender by condition interaction significantly predicted number of crashes (β = -.87, SE=.42, 95% CI = -1.69, -0.05). Plotting of the interaction showed males took more risks in the independent condition than in the group condition, whereas females showed the opposite effect. Probing of the interaction revealed that females crashed fewer times than males in the independent-passive condition (β = -.70, SE=.22, CI = -1.13, -.27), but the gender difference was non-significant for the group-active condition (β = .17, SE=.35, CI = -.52, .86).

Discussion

Our results suggest that peers' primary influence on adolescent driving may be through active, explicit channels. Peers exerted a stronger effect on driving via active versus passive routes, above and beyond the effects of having selected risky peers to complete the driving task. Friends may directly pressure or embolden youth to drive in a risky manner by goading and actively communicating risk-accepting behaviors to take risks (Allen et al., 2006; Dishion, et al., 1996). This active pressure puts youth at increased risk for crashing. Notably too, peers can also diminish risk taking though active channels, and encourage youth to drive slower and avoid accidents. Our results are consistent with previous research using confederates, in which the active peer influence of passengers both positively and negatively influenced risky driving in a simulated task. Shepherd and colleagues (2011) demonstrated that faster driving and many more accidents resulted when confederates encouraged adolescents to drive in a risky manner, relative to when adolescents drove alone. Moreover, confederates who encouraged slower driving generated safer driving behavior relative to youth driving by themselves (Shepherd, et al., 2011). Extending these findings with confederates to adolescents' actual peers, we found peers can explicitly increase or decrease risky driving though active channels. Adolescents had many more crashes when actively communicating with risky peers and had fewer crashes when actively communicating with low risk-inclined peers. Hence, risky friends actively impel youth towards greater risk taking, but less risky friends also actively "pull" youth in the direction of diminished risk taking.

A second key study finding is that risky youth are especially susceptible to peer influence, across both passive and active socializing conditions. Across both failure-latency to brake and crashes, risky youths (those with high risk preferences) were impelled towards risky driving by risk-inclined peers. In the passive condition, youth with higher peer risk preference engaged in risky driving at similar levels to those actively influenced. Notably, however, risky youths were “pulled” in the direction of diminished risk taking by less risky peers. For youths with low risk preference, the relation was less strong (i.e., the simple slopes were non-significant in both driving models). Importantly, these interactions were significant above and beyond the effect of peer group risk. Thus, risk-averse peers may communicate their norms in nonverbal ways, because they are less willing to vocalize caution. Cautioning peers to slow-down may be regarded as an unpopular or ineffective strategy. Indeed, in research on active decisions made in pairs, less risk-averse partners had diminished influence on the final decision the pair chose together (Deck, Lee, Reyes, & Rosen, 2012). Thus, verbally communicating risk-averse preferences was relatively ineffective for final decisions. In our study, peers may choose other, more passive channels by which to communicate their unfavourable attitudes towards risk.

Peer influence clearly does not entirely depend on verbal communication, and our results are consistent with previous research to this effect. However, we cannot directly ascertain from this research the mechanism of passive influence. One possibility is that adolescents intuitively “read” the behavioral expectations of their peers (Blakemore, 2008; Pfeifer et al., 2011). In a longitudinal study of adolescents’ neural responses to emotion, Pfeifer and colleagues’ (2011) findings suggested that *resistance* to peer influence may develop through improved regulation of responses to peers’ emotional expressions. Thus, our findings, as well as other findings, are consistent with the suggestion that adolescents conform to their friends’ behavioral expectations, possibly because they are attuned to their expressions of approval (e.g., Blakemore, 2008; Pfeifer & Allen, 2012). Importantly, our work extends research on peer influence to positive peer influence. Risky adolescents were influenced to take fewer risks when in the presence of low risk-preference peers, suggesting peers can help “pull the brake” on adolescent risk taking either via implicit or explicit communication.

These results offer some interesting possibilities in terms of intervention strategies to reduce dangerous driving. In addition to training adolescent drivers to buttress themselves against risky peers who encourage and promote dangerous driving, youth who are less risk-inclined could be trained as passenger-bystanders. Risk-averse passengers may be able to communicate descriptive norms that would “pull the brakes” on dangerous driving. Such passive communication is more subtle, and arguably may be easier and more effective for risk-averse youth to transmit. Thus, even without direct pressure or communication to slow down or stop, peers can transmit descriptive norms for safer driving, and adolescent drivers could implicitly infer which behaviors their peers will value and for which they will be rewarded (Carter, Bingham, Zakrajsek, Shope, & Sayer, 2014; Harakeh, & Vollebergh, 2012 Ouimet et al., 2013; Simons-Morton et al., 2011).

We also examined whether gender moderated the effect of active versus passive peer influence on adolescent risk taking. Although prior research indicates that proximal peers or passengers increases young males’ risk taking (Centifanti & Modecki, 2013; Lambért-Belanger et al., 2012; Simons-Morton et al., 2005; Simons-Morton et al., 2009), our results found only a trend-level effect in the opposite direction. The presence of peers who actively communicated about risky decision making incited female adolescents, but not male adolescents, to take more risks such that they took more time to brake at yellow or red traffic lights. This trend parallels Shepherd and colleagues’ (2011) finding that female adolescents were more heavily influenced by risk-encouraging confederate peers than were male adolescents. Research on risky driving has also found peer riskiness (i.e., peer alcohol involvement) had a greater influence on young females' risk taking than on young males' risk taking (e.g., Elliott et al., 2006).

Peers' attributes, based on self-report of actual peers, were of particular interest in examining risk taking in the present study. That is, we directly assessed the risk preferences of the target participants' close friends. This is important since research findings may differ based on whether actual peers or confederates are included. Throughout development, peers are powerful socializing agents, and influence occurs through frequent and intense interactions over time (see Hartup, 2009). Thus actual friends provide a strong opportunity to examine passive socialization effects. Moreover, because our models included measures of actual (as opposed to perceived) peer risk preference, we can rule out the possibility of a false-consensus effect. Thus, we eliminated the possibility that youths with a strong preference for risk may have assumed that their friends would likewise take risks (Prinstein & Wang, 2005; Rebellon & Modecki, 2013).

Building on a small but growing body of work, our findings underscore the key role conformity plays to meet the attributes of one's peers in adolescent risk taking. In our study, the effects of conforming to peers' risk preferences were as strong as or stronger than the individual's own preference for risk taking. Other research has also delineated a fundamental role for such proximal (i.e., close friends) peer characteristics in adolescent decision making. For instance, in an experimental study, Cohen and Prinstein (2006) demonstrated a peer socialization process such that adolescents acted in an aggressive or exclusionary manner in the presence of aggressive and risky peers. Likewise, Crosnoe and colleagues (2004) used longitudinal data to demonstrate contextual-level peer effects (e.g., schoolmates' and friends' drinking behavior) on risky drinking, showing that the peer context is highly salient to adolescent risk taking. However, the present study is the first known study to experimentally manipulate passive versus active influence of peers within the same study, in tandem with measuring and accounting for peer attributes. In so doing, the present study suggests that youth are more heavily socialized under conditions of active relative to passive influence. Of importance, socialization can work to diminish, as well as increase, adolescent risk taking.

Mechanisms of peer influence have not yet been cleanly isolated in the literature; our emphasis on real-life group decision making involved trade-offs in our ability to completely rule out effects of selection. Our results are consistent with previous findings demonstrating that passive peer influence from confederates affects youthful driving (Simons-Morton et al., 2014). The consistency bolsters support for the notion that our passive effects represent passive peer influence, rather than selection effects in which youth with a proclivity toward risk taking simply brought along risk taking friends. Moreover, our results indicated a differential effect of peers across two channels of influence. Had our results been attributable to selection effects, we would not expect to find a significant interaction between condition and the level of risk preferred by peers or target. Instead, we did found significant condition interactions for crashes and risky behavior at intersections. Most importantly, because our focus was on higher-order interaction effects in models that predict risk taking above and beyond effects of peer-risk, selection effects presumably play a limited role in our findings.

Despite a number of strengths, several other limitations also need to be acknowledged. First, although participants were encouraged to bring their friends, friends were limited to those of the same gender. Adolescents tend to spend time with a mix of male and female peers and adolescents may take more driving risks with male versus female passengers, regardless of the target’s gender (Simons-Morton et al., 2005). Thus, future research should explore the effects of mix gender peer-groups. Second, the present study only included school friends, and research suggests that friends from the community may exert relatively greater antisocial influence than do school peers (Kiesner, Kerr, & Stattin, 2004;

Muñoz et al., 2008).Third, in our study, adolescents completed the risk preference measure after randomization, which could affect the relative independence of the peers' risk preference measure. Target and peer risk preference was more strongly related in the active influence condition than in the passive influence condition. Future research that focuses only on behavioral outcomes should measure preference for risk and other individual characteristics prior to assigning youth to condition. Fourth, the self-reported risk preference measure was only weakly related to task measures of risk taking. However, researchers have similarly reported small to moderate correlations between another widely used experimental risk task (the Balloon Analogue Risk Task) and actual risk involvement (Lejuez et al., 2002). Behavioral and self-report measures of impulsivity also show weak correlations (Reynolds, Ortengren, Richards & de Wit, 2006). Together, these findings suggest that risk taking, like impulsivity, may reflect domain-specific assessments, which may not necessarily be expected to be strongly related. A final limitation relates to our experimental manipulation of passive versus active socialization. Future research would benefit from a third condition, in which youth "drive" in complete isolation. This would help to further isolate the effects of peer-socialization from peer-influence, and we would encourage future research to include a condition in which there were no peers present.

The present study has a number of important strengths. First, the research was based on a large representative sample. Participants were recruited from diverse areas and were diverse in ethnicity and socio-economic status. In addition, the study used a behavioral measure of risk taking as well as a self-report measure of risk preference in hypothetical scenarios, which represents a considerable methodological strength. Further, the driving task had strong face validity and used a first-person perspective with accompanying loud rock music to measure adolescent risk taking (Chein et al., 2011). Finally, we used friends' reports of risk taking, as opposed to youths' perceptions of their friends' risk taking. Research that relies solely on adolescent reports of their peers' behavior is inadequate, because it measures both peers' riskiness and youthful projections of their own risk behaviors (Rebellon & Modecki, 2013).

When adolescents choose to engage in risky behavior, it is almost always in the presence of familiar peers. Peers convey their behavioral expectations indirectly vis- à -vis perceived approval to take risks and also directly, by encouraging others. The results of this study indicate that adolescents are most heavily influenced to meet the behavioral expectations of their peers through active socialization channels. Friends' risk preferences "drove" adolescents' decisions to take risks in a simulated driving task when actively communicating about risk. Risky adolescents were most susceptible to peer influence, across both active and passive conditions of influence. Importantly, all of these results point to peers' ability to diminish risk taking. Youths who expressed a high preference for risk taking took fewer risks when in the presence of low risk-preference friends, even when not verbally communicating. Thus, interventions may benefit from targeting refusal and resistance strategies that allow adolescent drivers to resist overt pressures to engage in dangerous driving. Further, focusing on passengers, interventions could encourage youths to communicate risk aversion not only through active channels, but also through more subtle and implicit peer influence which arguably may be a more comfortable form of communication for some youths.

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Table 1.

Variance in Gender, Condition, Peer Levels, and 2-Way Interaction Predicting Self-Reported Risk Preference.

	Risk Preference (N=675)				
	Beta	SE	CI Low	CI High	-2LL (df)
Random slope step 1					2946.11 (8)
Covariates					
Intercept	9.15	0.15	8.86	9.44	
Gender (female=1)	-0.47*	0.18	-0.82	-0.12	
Condition (group=1)	0.13	0.17	-0.2	0.46	
Level 1 peer variance	0.02*	0.01	0.002	0.03	
Level 2 peer variance	0.29*	0.02	0.25	0.33	
Random slope step 2					2934.10 (9)
Covariates					Δ -2LL=12.01*
Intercept	9.11	0.15	8.82	9.4	
Gender (female=1)	-0.50*	0.18	-0.85	-0.15	
Condition (group=1)	0.18	0.17	-0.15	0.51	
Peer Risk x Condition	0.15*	0.04	0.07	0.23	
Level 1 peer variance	0.02*	0.01	0	0.03	
Level 2 peer variance	0.21*	0.03	0.15	0.27	

Note: *$p < 0.05$; CI = 95% Confidence intervals; Peer Risk= Sum of peer reported risk preference.

Table 2. Variance in Gender, Self-Reported Risk Preference, Condition, Peer Levels, and 2-Way Interactions Predicting Observed Risk-Taking.

	Failure/Latency to Brake (in ms; N=452)					Number of Crashes (N=452)				
	Beta	SE	CI Low	CI High	-2LL (df)	Beta	SE	CI Low	CI High	-2LL (df)
Step 1					9202.74 (6)					1847.87 (5)
Covariates										
Intercept	29267	514	28260	30274		4.52	0.14	4.25	4.79	
Gender (female=1)	-1092.98	685.05	-2435.68	249.72		-0.47*	0.19	-0.84	-0.1	
Condition (group=1)	-283.42	713.38	-1681.65	1114.81		0.11	0.21	-0.3	0.52	
Target Risk	160.94	179.41	-190.7	512.58		0.05	0.06	-0.07	0.17	
Peer Risk	107.01*	49.23	10.52	203.5		0.02*	0.01	0	0.04	
Level 1 peer variance	3267227	2527163	-1686012	8220466		n/a	n/a			
Level 2 peer variance	-14614.27	1684631.035	-3316491	3287263		n/a	n/a			
Step 2					9189.90 (9) Δ -2LL=12.84*					1832.40 (9) Δ -2LL=15.47*
Covariates										
Intercept	29368	514	28361	30375		4.63	0.15	4.34	4.92	
Gender (female=1)	-1211.34	682.237	-2548.53	125.85		-0.70*	0.21	-1.11	-0.29	
Condition (group=1)	-488.27	720.39	-1900.23	923.69		-0.36	0.3	-0.95	0.23	
Target Risk	477.38*	198.87	87.6	867.17		0.13*	0.06	0.01	0.25	
Peer Risk	60.28	54.61	-46.76	167.32		-0.01	0.02	-0.05	0.03	

Target Risk x Condition	-1179.68*	570.89	-2298.62	-60.74		-0.27	0.17	-0.06	0.6	
Peer Risk x Condition	123.88	98.95	-70.06	317.82		0.08*	0.03	0.02	0.14	
Target Risk x Peer Risk	-67.70*	25.85	-118.37	-17.03		-0.02*	0.01	0	-0.04	
Gender x Condition	-	-	-	-		0.87*	0.42	0.05	1.69	
Level 1 peer variance	3742496	2467779	-1094351	8579343		n/a	n/a			
Level 2 peer variance	26223.8	21496.4	-15909.14	68356.74		n/a	n/a			

Note: *p < 0.05; CI = 95% Confidence intervals.

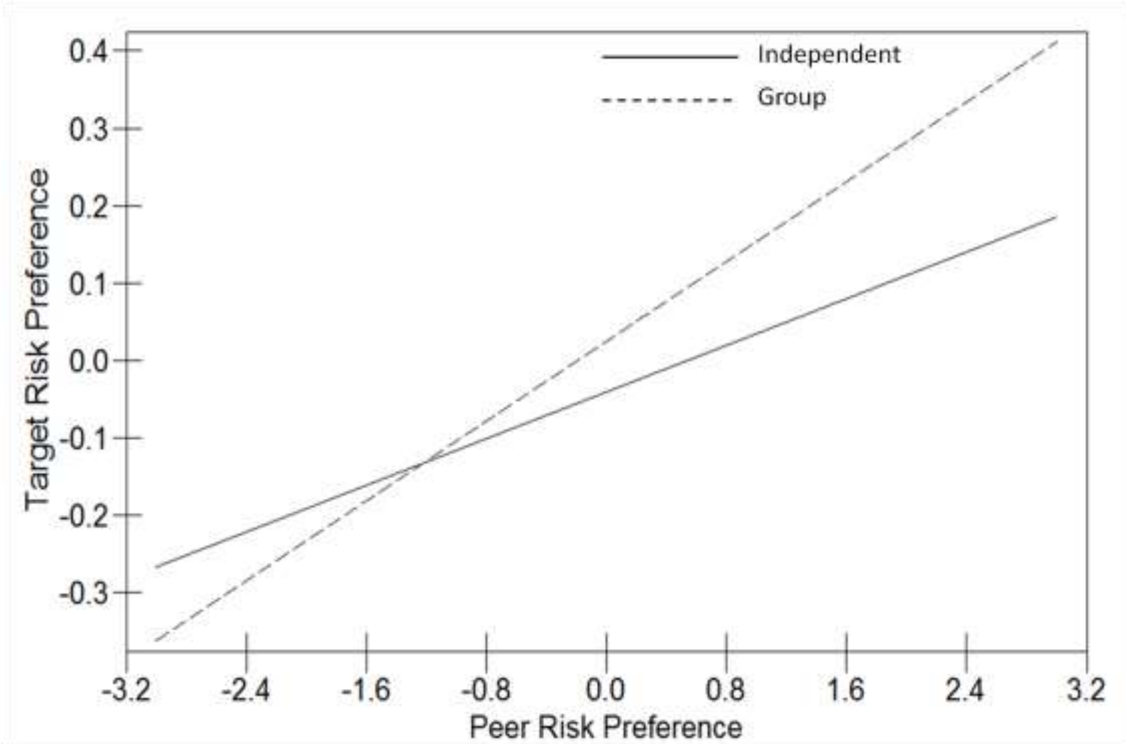

Figure 1. Interaction Between Peers' Reported Risk Preference and Group Condition on Standardized Scores of Self-Reported Risk Preference.

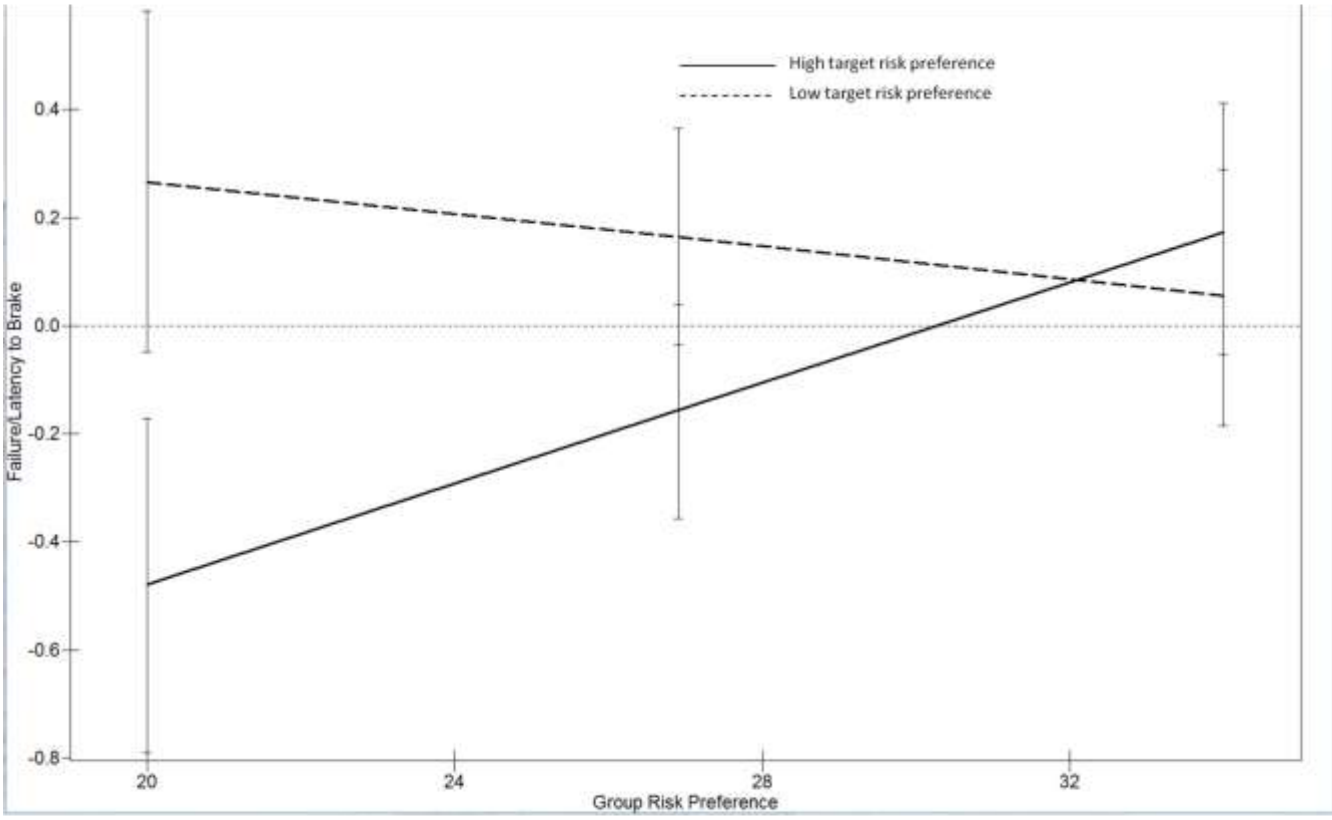

Figure 2. Interaction Between Peers' Risk Preference and Target Risk Preference on Standardized Scores of Failure-Latency to Brake (with 95% Confidence Intervals).

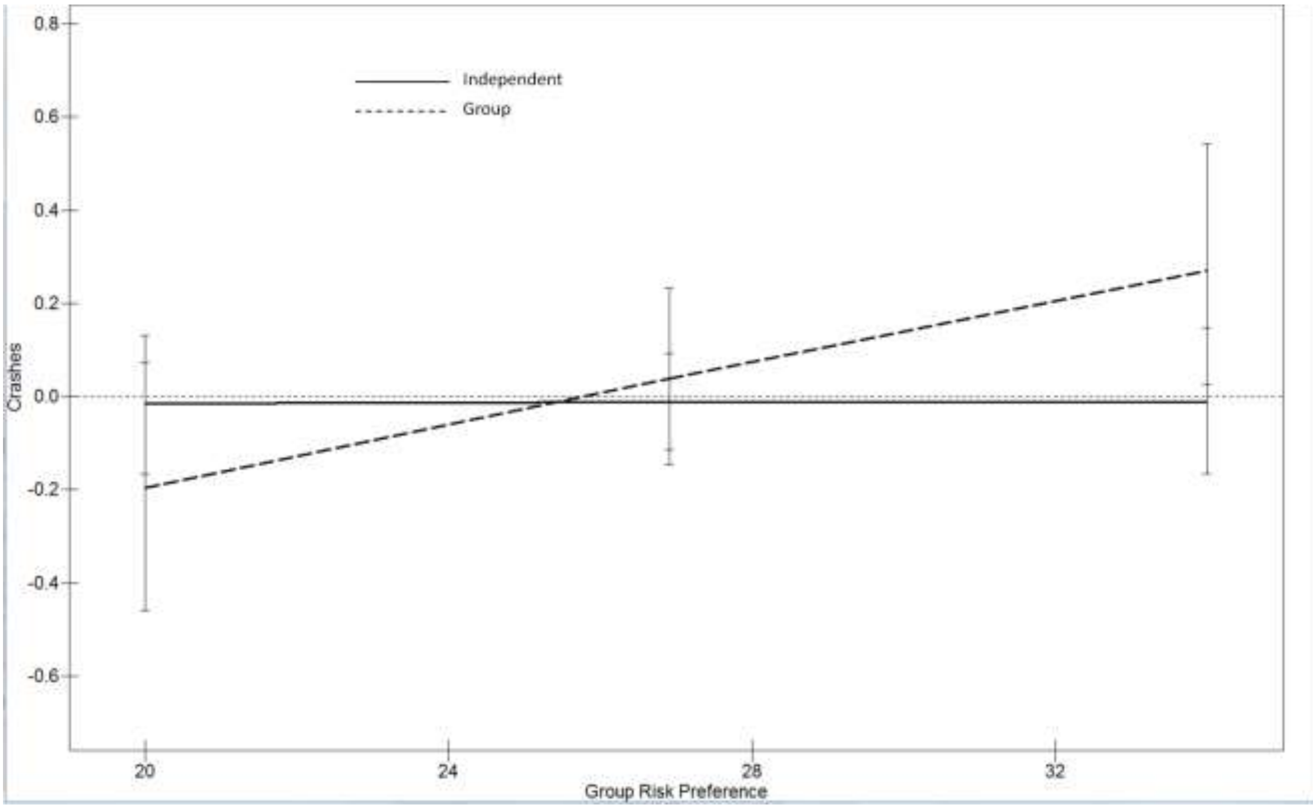

Figure 3. Interaction Between Peers' Risk Preference and Group Condition on Standardized Scores of Number of Crashes (with 95% Confidence Intervals).